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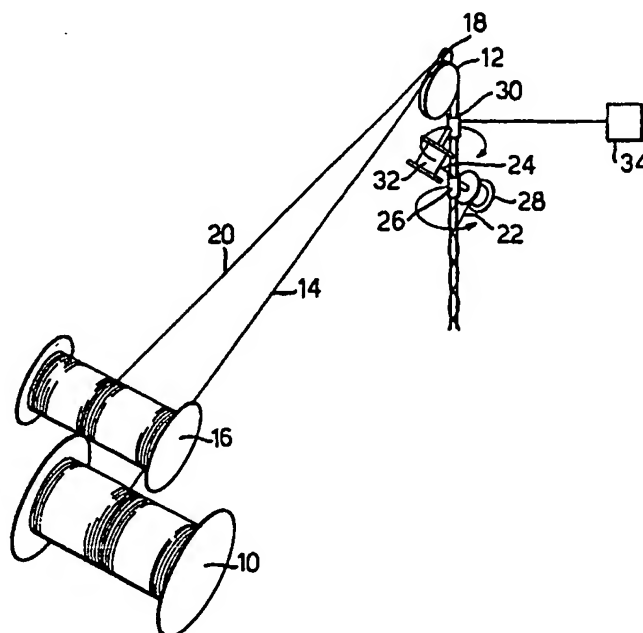
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(54) Title: APPARATUS AND METHOD FOR HANDLING CABLES



(57) Abstract: Apparatus for handling cables is disclosed. The apparatus comprises means (10, 12, 16, 18) to pay out a service cable (20) and a support cable (14) so that the service cable (20) and the support cable (14) are adjacent, and means to (26, 28) wrap a further cable (22) around the service and support cables (20, 14).

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**APPARATUS AND METHOD FOR HANDLING CABLES**

The present invention relates to an apparatus and a method for handling cables. More specifically, the invention relates to apparatus and a method, which are  
5 useful for deploying and retrieving equipment in subsea and subsurface locations using cables.

All underwater remotely operated vehicles (ROVs) rely on an umbilical for power and signals transmission to and from the surface support vessel. The umbilical must also be capable of supporting the mass of the ROV during launch and  
10 recovery operations (dynamic factors can result in a five fold increase in mass). As the operating depth increases the umbilical design has to take account of the weight of the cable deployed and launch mass problems become less of an issue.

For this reason, traditional ROV armoured umbilicals have been constructed as a composite of copper wires wrapped in an outer steel wire braid with a fibre optic  
15 core. The 'braid' provides the umbilical with enough strength to withstand the high loads placed on the umbilical.

There are a number of problems associated with this approach. The umbilical is stiff and hard to deflect. It has a fixed internal configuration, which cannot be altered. The steel strength members corrode with time. The delicate fibre optic cores  
20 become damaged with use rendering the entire umbilical useless. Furthermore, the minimum bend diameter is large, requiring large sheave wheels, winches etc.

However, the most significant drawback is weight. This may not be so much of a problem in shallower waters but as depth increases the weight of cable deployed becomes more significant until a point is reached where the cable can no  
25 longer support the deployed load and its own weight. For this reason it is generally recognised that 3000 metres is the practical limit for this type of umbilical.

In EP-0805776 there is described an alternative approach which does not rely on the use of a steel armoured umbilical. This specification discloses an apparatus in which a conventional underwater service cable is wrapped around a load-bearing  
30 rope during deployment. The service line is subsequently unwrapped when the rope is recovered. This apparatus requires that the winch for the service cable must rotate around the load-bearing rope, and this results in a complicated structure.

We have now found a way to avoid the problems in the prior art, which involves wrapping a further line around a support line and a service line. In accordance with the invention we provide an apparatus and method for achieving this.

5        Thus, according to one aspect of the invention we provide apparatus for handling cables, comprising means to pay out a service cable and support cable so that the service cable and the support cable are adjacent, and means to wrap a further cable around the service and support cables.

10        The means for paying out the support cable may comprise a winch, and usually also includes a sheave. Similarly, the means for paying out the service cable may comprise a winch, and usually also includes a sheave. The arrangement is preferably such that the sheaves guide the service and support cables so that they extend substantially vertically, in juxtaposition with one another, so that the further cable can be wrapped around them. As the service and support cables are paid out  
15 they will move axially while the further cable is being wrapped around them.

The winch for the service cable may relatively light duty (compared with the support cable winch). The cables can each be wrapped around their respective winches to facilitate storage. Appropriate slip rings may be fitted to facilitate continuity during deployment and recovery.

20        The means for wrapping the further cable may comprise a tubular member through which the service and support cables extend in juxtaposition, and a winch secured to the tubular member for paying out the further cable. The winch and the tubular member are preferably rotatable about the service and support cables so that the further cable is wrapped around the service and support cables during rotation of  
25 said winch and tubular member. Drive means can be provided to drive the winch and the tubular member around the service and support cables. The winch and tubular member may be rotated in one direction to wrap the further cable around the service and support cables (for deployment), and may be rotatable in an opposition direction to unwrap the further cable from the service and support cables (for retrieval).

30        Preferably there is more than one of said further cables wrapped around the service and support cables, and most preferably two of said further cables are used. Each further cable may be provided with its own tubular member, winch and drive

means. However, if desired, a common drive means can be provided for rotating the winch and tubular member of the first and second further cables (and any other further cable).

Preferably one of the further cables is wrapped around the service and  
5 support cables in one direction, and another of the further cables is wrapped around the service and support cables in an opposite direction, so as to braid the service and support cables with the further cables.

Preferably, the winches of the first and second tubular members are geared so that they rotate around the service and support cables in synchrony.

10 Preferably means is provided for increasing or decreasing the speed of rotation of the or each further cable.

Preferably means is provided to adjust the tension of the or each further cable as it is wrapped around the service and support cables.

The service cable may be designed to carry power and/or data, for example,  
15 to a subsea or subsurface location. Usually the power and/or data will be carried to subsea or subsurface equipment, such as an underwater ROV . The service cable may be entirely conventional and may include one or more electrical, fibre optic, hydraulic and/or pneumatic lines. More than one service cable may be used, in which case the further cable is preferably wrapped around all the service cables - in  
20 this embodiment, each service cable would usually be provided with its own winch and sheave. The service cable may be of the type of cable known in the art as an "umbilical".

The support cable may be a load bearing cable adapted to support its own weight and the weight of the service cable(s). It is particularly preferred that the  
25 support cable is specially adapted for use in lifting operations. The support cable may be a metallic material, such as steel, or may be a plastics material. Preferably, the support cable is a synthetic fibre rope such as ultra high molecular weight polyethylene. The support cable may be KEVLAR (registered trade mark). The support cable may be provided with reinforcement. The support cable may be often  
30 the type known in the art as a "lift" cable.

The or each further cable may be the same as the support cable. Typically, however, the or each support cable would be of lighter duty than the support cable.

Thus, the or each further cable may be a metallic material, such as steel, or may be a plastics material. The or each further cable may be a synthetic fibre rope such as ultra high molecular weight polyethylene. The or each further cable may be KEVLAR (registered trade mark).

- 5        According to another aspect of the invention we provide a method for handling cables, comprising paying out a service cable and a support cable so that the service cable and the support cable are adjacent, and wrapping a further cable around the service and support cables.

Preferably two of said further cables are wrapped around the service and  
10 support cables, one of the further cables being wrapped around the service and support cables in one direction and the other of the further cables being wrapped around the service and support cables in an opposite direction, so as to braid the service and support cables with the further cables.

The present invention facilitates the deployment of a subsea 'package' with  
15 multiple service lines which are dynamically 'braided' to the main support line as the package is deployed or recovered.

During recovery operations, the further cable can be 'undone' by reversing the direction of rotation of the winch carrying it. The further cable may then be recovered back onto a storage reel which forms part of the winch.

- 20        The present invention is very flexible, allowing easy replacement of service lines in the event of damage. It allows braiding of any type of service line (including a multitude of service lines) to any type of lift line over any distance. Furthermore, more than one lift line can be provided, if desired, usually with its own sheave and winch arrangement. The invention allows the use of low density, high strength  
25 support lines to increase the deployment depth capability beyond conventional umbilicals to full ocean depth.

Existing equipment can easily be adapted for use with the invention. Control system service lines could be attached to flexible flowlines as they are laid in field. Riser, service lines, returns line etc. could be braided together as they are deployed  
30 during subsea well intervention operations.

The invention also offers significant advantages over the invention described in EP-0805771. For example, no complex rotating service winches with multiple slip

rings are required: a conventional deck mounted service winch will do. Thus, the rotating assemblies can be much smaller. Furthermore, the invention can cater for larger number and diversity of service lines, and is more readily adaptable to alternative service line types.

- 5       Reference is now made to the accompanying drawing, which is a schematic perspective view illustrating the apparatus and method according to the present invention.

10       In Figure 1 a support cable winch 10 and a support cable sheave 12 are provided for paying out a support cable 14 which is typically a lifting rope. A service cable winch 16 and a service cable sheave 18 are provided for paying out a service cable in the form of umbilical 20. The sheaves 12 and 18 are arranged to feed the service and support cables 20,14 substantially vertically in juxtaposition with one another.

20       The service and support cables 20,14 are fed to a "braiding" unit which braids two further cables 22 and 24 around the service and support cables 20,14. The braiding apparatus includes a tubular member 26 and winch 28 for wrapping the further cable 22 around the service and support cables 20,14. The braiding apparatus further includes a tubular member 30 and winch 32 for wrapping the further cable 24 around the service and support cables 20,14. Drive means 34 is provided for rotating the tubular member 26 and winch 28 around the service and support cables 20,14 in a clockwise direction. The drive means 34 may also serve to rotate the tubular member 30 and winch 32 around the service and support cables 20,14 in an anticlockwise direction, or, alternatively, as separate drive means (not shown) may be provided for this purpose.

25       Thus, the braiding unit consists of two contra-rotating high capacity reels (i.e. the winches 28 and 32) of a small diameter braiding line. The reels 28,32 are preferably driven such that the braid line is constantly in tension. As the service and support cables 20,14 move axially downward, the reels 28,32 are driven around, paying out the further cables 22,24 and binding the service cable 20 to the main lift cable 14 and forming a bundle in a similar fashion to rope manufacturing equipment. Both reels 28,32 are mechanically geared together such that each rotates around the bundle in synchrony (this helps to avoid entanglement). Increasing or decreasing the

speed of rotation of the braiding unit, relative to the rate of bundle throughput, will result in different weave rates. Similarly, increasing the braiding reel back tension will result in a tighter weave.

It will be appreciated that the invention described above may be modified.



**CLAIMS**

1. Apparatus for handling cables, comprising means to pay out a service cable and support cable so that the service cable and the support cable are adjacent, and  
5 means to wrap a further cable around the service and support cables.
2. Apparatus according to claim 1, wherein the means for paying out the support cable comprises a winch and a sheave, the support cable extending from the winch and over the sheave.  
10
3. Apparatus according to claim 1 or 2, wherein the means for paying out the service cable comprises a winch and a sheave, the service cable extending from the winch and over the sheave.
- 15 4. Apparatus according to any preceding claim, wherein the means for wrapping the further cable comprises a tubular member through which the service and support cables extend in juxtaposition, and a winch secured to the tubular member for paying out the further cable.
- 20 5. Apparatus according to claim 4, wherein the winch and the tubular member are rotatable about the service and support cables so that the further cable is wrapped around the service and support cables during rotation of said winch and tubular member.
- 25 6. Apparatus according to claim 5, further comprising drive means to drive the winch and the tubular member around the service and support cables.
7. Apparatus according to an preceding claim, further comprising means to increase or decrease the speed with which the further cable is wrapped around the  
30 service and support cables.
8. Apparatus according to any preceding claim, further comprising means to

adjust the tension of the further cable as it is wrapped around the service and support cables.

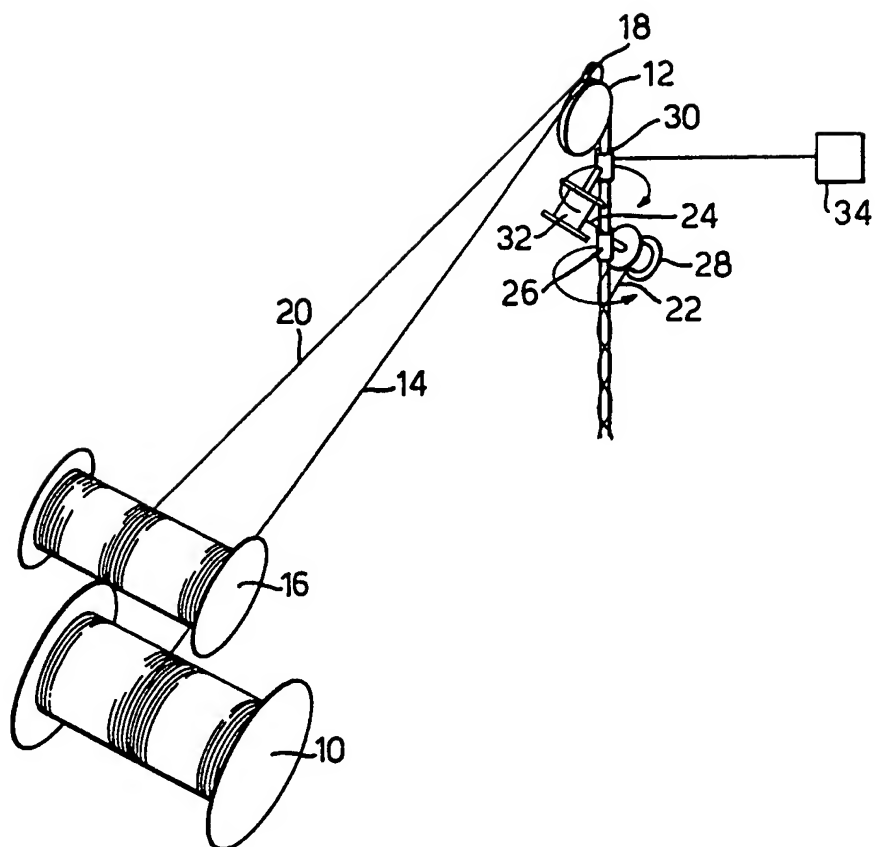
9. Apparatus according to any preceding claim, further comprising a second  
5 further cable, and means to wrap the second further cable around the service and support cables in a direction opposite to the first further cable, whereby the further cables are braided around the service and support cables.

10. Apparatus according to claim 9, wherein the means for wrapping the second  
10 further cable comprises a tubular member through which the service and support cables extend in juxtaposition, and a winch secured to the tubular member for paying out the second further cable, the winch and the tubular member being rotatable about the service and support cables so that the second further cable is wrapped around the service and support cables during rotation of said winch and tubular  
15 member, and drive means to drive the winch and the tubular member around the service and support cables.

11. A method for handling cables, comprising paying out a service cable and support cable so that the service cable and the support cable are adjacent, and  
20 wrapping a further cable around the service and support cables.

12. A method according to claim 11, wherein two of said further cables are wrapped around the service and support cables, one of the further cables being wrapped around the service and support cables in one direction and the other of the  
25 further cables being wrapped around the service and support cables in an opposite direction, whereby the service and support cables are braided with the further cables.

Fig.1.



# INTERNATIONAL SEARCH REPORT

International Application No.  
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## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B66C13/14

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B66C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 96 22935 A (DEEP WATER RECOVERY & EXPLORAT ;CRAWFORD ALEXANDER CHARLES (GB)) 1 August 1996 (1996-08-01) cited in the application the whole document	1-3,7-9, 11,12
A	FR 1 583 350 A (CARL SCHENK MASCHINENFABRIK GMBH) 24 October 1969 (1969-10-24) the whole document	1,11

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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